

# *Manual of* Gypsum Drywall Construction



**GYPSUM DRYWALL CONTRACTORS INTERNATIONAL**

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## FOREWORD

Historically, gypsum drywall construction made its debut about 1915, when, unlike today's industry, only small sheets of  $\frac{3}{8}$ " thick board were made and used solely for remodeling. Systems of joint concealment, primitive by today's standards, were soon developed after World War I; and during the next decade the product and techniques were considerably improved.

Although still far behind today's technique, World War II created an enormous appetite for prefabricated products to speed wartime construction. As a result, after the war when home construction boomed gypsum wallboard found much wider usage. The demand encouraged research and development of better job techniques; and this period marked the first entrance of the dry-wall contractor in home construction.

During recent years, vast sums have been expended on research and development to improve the component materials and application techniques. Today, gypsum drywall accounts for a significant portion of the national market for walls and ceilings. The Gypsum Drywall Contractors International believes that the further growth of our industry depends largely upon our ability to insure the highest possible standards of construction; and this manual is dedicated to that end.

## TABLE OF CONTENTS

I.	LUMBER AND FRAMING.....	1
II.	NAILS.....	3
III.	APPLICATION OF WALLBOARD.....	5
	Single-Ply.....	5
	General.....	5
	Floating Interior Angles.....	5
	Double Nailing.....	5
	Adhesive Nail-On.....	6
	In Bath and Showers.....	6
	Exterior Use.....	7
	Two-Ply.....	8
	General.....	8
	Stapling First-Ply.....	8
IV.	SELECTION OF JOINT SYSTEM PRODUCTS.....	8
V.	JOINT AND NAIL HEAD TREATMENT.....	9
VI.	DECORATION OF GYPSUM WALLBOARD.....	10
VII.	ELECTRIC RADIANT HEATING WITH TWO-PLY GYPSUM WALLBOARD.....	11
VIII.	DESIGN DATA.....	12
	Specifications.....	12
	Weights.....	12
	Thermal Conductivity Values.....	12
	Fire Resistance Ratings.....	13
	Sound Transmission Loss Ratings.....	13
	AMERICAN STANDARDS ASSOCIATION SPECIFICATIONS FOR GYPSUM WALLBOARD FINISHES.....	Appendix
	RECOMMENDED PERFORMANCE STANDARDS FOR NAILS FOR APPLICATION OF GYPSUM WALLBOARD.....	Appendix



## LUMBER AND FRAMING

The saying that "A chain is no stronger than its weakest link" can be applied in the construction of good gypsum wallboard interiors. Lumber and the manner in which it is framed into the building is one of the "links" that deserves special attention. Gypsum wallboard cannot be expected to conceal all defects in framing techniques or undue lumber shrinkage. The precautions to be observed are not extraordinary; but they pay handsome dividends in the excellence of the interior finish.

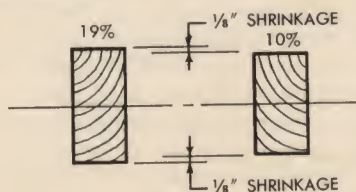
There are three areas in which lumber and framing can contribute to good interiors, including the wallboard.

1. The physical and structural characteristics of the lumber.
2. The installation and inspection of the lumber.
3. The accessories to the framing that are installed prior to the application of the wallboard.

### PHYSICAL AND STRUCTURAL CHARACTERISTICS

The most important physical feature of lumber that affects *any* interior finish is the moisture content. If, after being placed in a heated building, the lumber continues to lose moisture until it eventually stabilizes, it shrinks as it dries. This shrinkage is detrimental to any interior finishes, as well as to other portions of the building.

As shown in the detailed explanation in Section II on "Nails and Nailing," the most adverse effect of shrinkage of lumber is its contribution to nail popping. The greatest shrinkage takes place across the grain, that is across the  $3\frac{5}{8}$ " or the  $1\frac{5}{8}$ " dimension of a 2" x 4" stud. This shrinkage can be as much as  $\frac{1}{4}$ " in width—from  $3\frac{5}{8}$ " to  $3\frac{3}{8}$ ". This fact has been proved in many tests, some of which have been conducted at Forest Products Laboratory, Purdue University and Virginia Polytechnic Institute.



DIMENSIONAL CHANGE WHEN LUMBER DRIES FROM 19% MOISTURE CONTENT TO 10%

Drying of wet lumber also contributes heavily to buckling, warping, bowing and twisting of studs or framing members. This can be so severe as to cause distortion of the finished surface and even breaking or cracking of the wallboard itself.

In Table No. 41 of the "Wood Handbook No. 72", as published by the United States Department of Agriculture, Forest Products Laboratory, Madison, Wisconsin, it is recommended that lumber used in framing have a moisture content in the range of 11 to 13 per cent when used throughout the greater portion of the United States. In warm, dry areas—primarily Nevada and New Mexico—the moisture content should be in the range of 8 to 10 per cent. It is within this "range" that framing lumber will stabilize, about one year after installation in a heated building.

It has also been established that a reduction of moisture content of 6 per cent or more, can cause "nail-popping" in interior

finish and flooring, as well as other detriments to the structure. *It is therefore apparent and important that the moisture content of lumber used in framing should not exceed 14 per cent at the time of application of the interior finish.*

The "Wood Handbook No. 72" defines "air-dry lumber" as having a minimum moisture content in the range of 12 to 15 per cent—the average being somewhat higher.

"Kiln-dried" lumber is defined as having a moisture content in the range of 6 to 12 per cent, with common yard grades likely to have a somewhat higher moisture content.

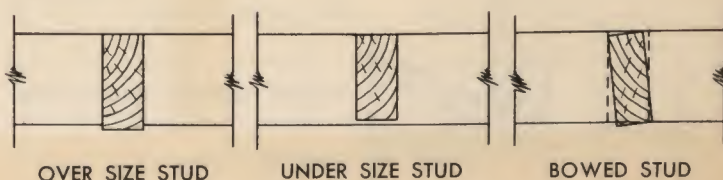
Therefore, it is improper to assume that "air-dried" or "kiln-dried" lumber is sufficiently dry, since the terms are not clearly defined. The maximum allowable moisture content of 14 per cent must be required. However, specifying 14 per cent moisture content lumber is still not enough, since in shipping, storage, transporting to the job, storing on the job, etc., often subjects lumber to moisture. It will readily absorb as much as 10 or 15 per cent more moisture, and be no better than before it was dried. Therefore, it is obvious that the framing lumber must be protected from the elements at all times until roofing and exterior sheathing is applied to the building.

The Federal Housing Administration (FHA) in its "Minimum Property Standards" for one and two living units, limits the moisture content to 19 per cent at the time of installation. Use of 19 per cent lumber (at time of framing) may be satisfactory, providing it is given an opportunity to dry before application of the interior finish.

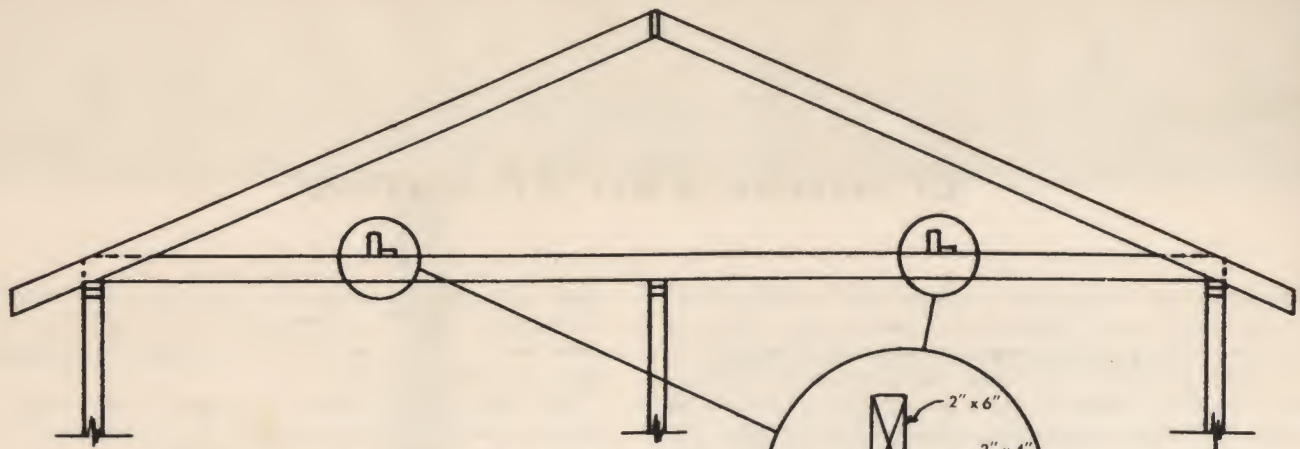
Usually several weeks elapse between the "roofing-in" of a home and the time when wallboard is applied, so further drying of the lumber is possible. This can be done by providing ventilation and heat in the building prior to the application of the wallboard. Actually, ventilation is probably more important in drying than heat is. Therefore, the general contractor should be instructed to leave windows open to promote ventilation. In addition, artificial heat or use of the heating unit, if installed, will greatly aid in drying. It must be emphasized that several weeks of good drying conditions are usually needed to appreciably reduce the moisture content of the lumber.

To determine the amount of moisture in lumber, a "moisture meter" is used. It should be obtained from a reputable manufacturer, and be of the type that has "prongs" for penetrating well into the wood. Those that measure surface moisture only should be avoided.

In addition to the moisture content of framing lumber, other physical characteristics are important for good wallboard performance. The dimensions of the lumber should be full size and uniform. If studs are not of the same width they can lead to irregular walls, loose nailing and difficulty in application of the board. Framing lumber should be true and straight, since bowed and twisted studs will also contribute to these difficulties.







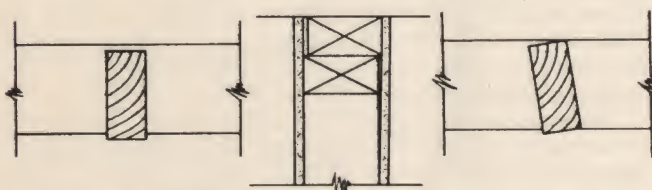
**METHOD TO LEVEL AND EVEN OUT JOISTS**

The design and selection of lumber sizes will also reflect in the gypsum wallboard finished job. Lumber should be of such physical characteristics, grain pattern and density that it develops the full design stress for which it is used, or expected. A stud that bows because it cannot carry its full load can cause difficulty, as can ceiling joists that deflect greater than  $1/360$  of their span.

When cross furring strips are used, they should be 2" x 2" nominal. Neither 1" x 2" or 1" x 4" furring strips give enough rigidity when used across framing members to provide a good nailing member for the application of gypsum wallboard. The vibration caused by nailing will usually loosen the wallboard on the adjacent nails that have been previously driven. If it becomes necessary to use 1" nominal furring strips, it is recommended that 2-ply laminated wallboard be applied. Over masonry, furring strips that are adequately shimed can be 1" x 2".

### INSTALLATION AND INSPECTION OF FRAMING LUMBER

Framing should be inspected prior to the application of the wallboard. It is important that the studs be in alignment with each other, as well as in alignment with the edges of the top and bottom plates. The same applies to ceiling joists.

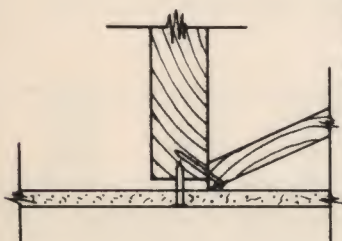


**STUD NOT FLUSH WITH PLATE**

**UNEVEN PLATES**

**STUD NOT FLUSH WITH PLATE**

Framing should be well nailed. The booklet entitled "Technique of House Nailing", as published by the U. S. Housing and Home Finance Agency, outlines minimum recommended nail size and spacing for all portions of residential frame construction. It is available from the Superintendent of Documents, Washington, D.C., at 20c per copy.



**WRONG METHOD OF FRAMING**

Framing should be inspected to be sure that edges of bridging are behind the nailing surface of joists. Also, if blocking is provided for fixtures, such as in bathrooms and kitchens, it should be properly aligned. Adequate framing members should also be provided at all corners.

Although not required, it is most helpful (particularly where ceiling joists are uneven) to secure a "strong back" across the center on the top side of the joists. This can consist of a 2" x 4" nailed "flat" down the center of the joists and a 2" x 6" securely nailed on edge along one side of the 2" x 4". This not only evens out the joist but adds rigidity; and therefore improves the nailing characteristics of the joists.

### ACCESSORIES TO FRAMING

In addition to inspecting the framing, other items can be checked at the same time.

Although not usually identified as framing, there are various items installed between the time a building is framed and the time when the wallboard is applied. They consist of electrical, heating, and plumbing facilities, and application of insulation. It is important that such equipment is properly installed and tested before the gypsum wallboard is applied.

It is particularly important that electrical "straps" for outlet boxes are either applied to the side of the studs or "notched" into the face of the studs so that the wallboard can be brought into firm contact with the face of the stud. This, of course, applies also to headers for plumbing fixtures and heat duct outlets. Window and door frames should be accurately aligned and properly set to afford the correct "ground" for the thickness of wallboard used. If "metal strap" corner bracing is used, and applied to the inside face of the studs, it should be "notched" or "let-in" to the face.

The flanges of insulation batts and blankets should be fastened to the sides of the studs—not the face, which is to receive the wallboard. Wrinkles in the paper flanges will make a poor base for nailing, and contribute to potential nailing difficulties.



**ATTACHMENT OF INSULATION BATT FLANGES**



## Section II

# NAILS AND NAILING

Of the vast research devoted to the gypsum wallboard industry, the portion relating to nail attachment is second only to joint concealment and reinforcement. Since the attachment is accomplished by a "blind" method to provide a blemish free surface, the technique is far different than ordinary nail securement.

Nail selection is important and the following analysis of various properties of nails is offered as a basis for the recommendations given later in this section.

### THE NAIL POINT

The purpose of the point is to provide for ease of penetration into the framing member. It also guides the nail through the wood. A long, slender point more readily follows the grain of the wood, and therefore may cause the nail to take an irregular or crooked path. This is significant in view of the fact that the nail must be kept at right angles to the face of the wallboard. A short pointed nail drives straighter than a long pointed nail, but requires more power to drive. Experience has shown that a medium-long diamond pointed nail will best serve the purposes for the application of gypsum wallboard.

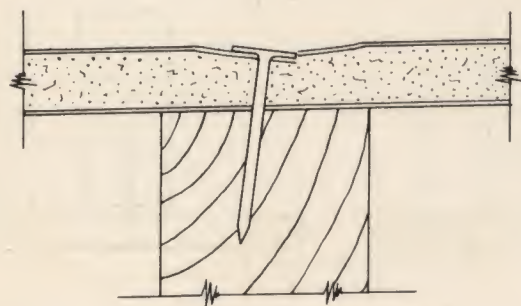
### THE NAIL SHANK

There are three features to a nail shank. They are the ductility, or hardness of the steel, surface treatment and the diameter. A nail shank of excessively hard steel tends to drive crooked by following the grain of the wood. In addition, if the nail shank is excessively thick it will not "adjust" and will tend to drive crooked. On the other hand, a nail shank that is too soft or too thin in diameter will bend or drive crooked. Typical nail wire as used by most nail manufacturers is satisfactory for nails used in gypsum wallboard. Special steels, offered as extra hard or extra soft, are not necessary and in some instances objectionable for the application of gypsum wallboard.

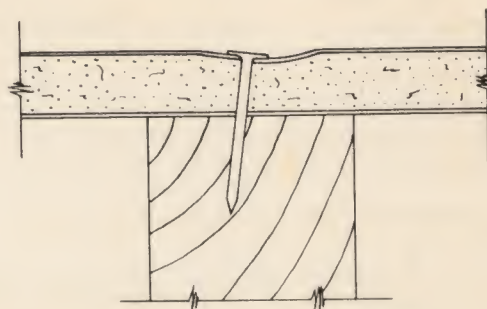
Nail shanks may be plated with thin inorganic or metallic materials for rust resistance compatible with the nail head treatment materials and paints used for decoration. "Cement," "rosin," "bituminous" or other such coatings are not recommended.

### THE NAIL HEAD

The function of the head of the nail is to support the material through which the nail is driven. It has often been thought that



NAIL HEAD DIAMETER TOO LARGE



CORRECT NAIL HEAD DIAMETER

the larger the head the better but this is not necessarily true.

The objections to the use of excessively large nail heads for the application of gypsum wallboard are:

1. If the nail is driven at an angle, the excessive cantilever distance caused by the large radius of the head will make it more conducive to cutting the paper.
2. A large head is more conducive to shadowing which is caused by condensation or temperature differential in the steel in exterior walls or ceilings under unheated areas.

This temperature differential is caused by transmission of the heat or cold in exterior walls or ceilings through the wood framing member and through the shank of the nail, eventually causing shadowing or discoloration at the nail head. The more steel, the more likely is this condition to occur.

A head that is too small will not provide enough holding power to support the board. The ratio of the area of the head to the diameter of the shank is important. Assuming a  $\frac{1}{4}$ " head is satisfactory, such a head with a shank diameter of  $\frac{3}{16}$ " would not leave enough surface to support the wallboard. The maximum recommended head diameter is  $\frac{5}{16}$ " and minimum area of head minus shank area is .037 square inches. The head must be designed so that it can be dimpled with a crown face hammer without breaking the paper. It should be flat, or slightly concave, and its outer edges should be thin. A slight fillet is recommended at the shank. Nails with "casing" type of head, or "common" nails, should definitely be avoided.



ACCEPTABLE NAIL HEADS



UNACCEPTABLE NAIL HEADS



## THE LENGTH OF NAIL

The purpose of the nail length is to provide holding power. Based on this concept, it might seem that the longer the nail, the more holding power; and the better the result. However, based on recent research conducted within the gypsum wallboard industry, it has become apparent that the contributing factor to nailing difficulties lies in shrinkage of lumber (see "Framing" in Section I). In addition, the withdrawal of nails is progressive with alternate cycles of moisture content.

The shrinkage across the width of a 2" x 4" stud, as mentioned earlier, can be as much as  $\frac{1}{8}$ " away from each face of the stud. The amount of this shrinkage, which is detrimental to the wallboard construction, is based on the distance from the face of the stud to the center of the holding power of the shank. In almost all cases, the latter is about  $\frac{1}{2}$  the penetration of the shank of the nail into the nailing member. Therefore, if a nail penetrated 2", the shrinkage affecting the wallboard would be from the face of the stud to 1" inside the face. This shrinkage could be as much as  $\frac{1}{16}$ ".

With a nail that provided 1" penetration, the shrinkage reaction would be caused by a  $\frac{1}{2}$ " thickness of wood, and would be approximately  $\frac{1}{32}$ ". It therefore becomes apparent—assuming adequate holding power—that the less the penetration of the nail, the less effect shrinkage will have upon the final gypsum wallboard construction.

With full recognition of the requirements of nails as herein delineated, the GDCI has prepared a Recommended Performance Standard for nails for application of gypsum wallboard (see Appendix). Nails complying with this standard and meeting the test requirements should be satisfactory.

It is suggested that all nails used for application of gypsum wallboard be tested at a nationally recognized testing labora-

tory, such as the Armour Research Foundation, Chicago; Smith-Emery Company, Los Angeles; or Pittsburgh Testing Laboratory, to determine compliance.

Special attention is drawn to the specific nail requirements that the maximum penetration should be  $\frac{7}{8}$ "; the maximum diameter of the head be  $\frac{19}{64}$ ", and of such design that it can be "dimpled" without breaking the paper. In addition, both the immediate and delayed holding power should be equal to or exceed that of a 13½ gauge bright finish nail driven to a penetration of 1".

Among others, the following nails meet the performance requirements:

### For $\frac{3}{8}$ " Thick Wallboard

$\frac{1}{8}$ " or  $\frac{1}{4}$ " GWB-54 annular ringed nail complying with ASTM C380-58T

$\frac{1}{4}$ ", .098 diameter smooth bright finish nail with head conforming to ASTM C380-58T

$\frac{1}{4}$ ", 13 gauge acid etched phosphate coated, "cupped" head.

### For $\frac{1}{2}$ " Thick Wallboard

$\frac{1}{4}$ ", GWB-54 annular ringed nail complying with ASTM C380-58T

$\frac{1}{8}$ ", .098 diameter smooth bright finish nail with head conforming to ASTM C380-58T

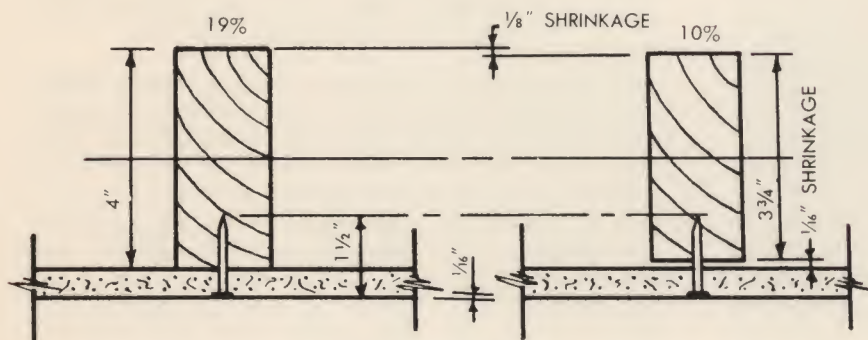
$\frac{1}{8}$ ", 13 gauge acid etched phosphate coated, "cupped" head.

### For $\frac{5}{8}$ " Thick Wallboard

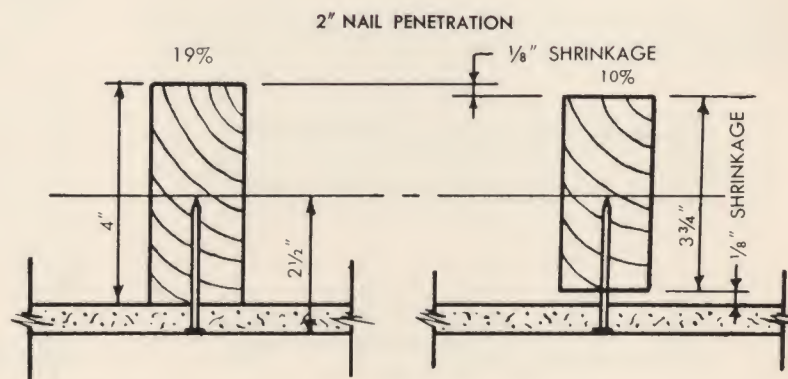
$\frac{1}{8}$ ", GWB-54 annular ringed nail complying with ASTM C380-58T

$\frac{1}{2}$ ", .098 diameter smooth bright finish nail with head conforming to ASTM C380-58T

$\frac{1}{2}$ ", 13 gauge acid etched phosphate coated, "cupped" head.



1" NAIL PENETRATION



EFFECT OF SHRINKAGE VS. NAIL PENETRATION



## APPLICATION OF WALLBOARD

It must be remembered that gypsum wallboard is a prefabricated finish that must be handled with care, just as it is necessary with doors and trim which are also finish materials. All such materials should be kept dry, preferably stored within the building. If outside storage is necessary, the board should be stacked on platforms above the ground and fully protected from the weather, as well as fully supported. Care should be taken to avoid damage to edges and corners. Scuffing of the surface should be avoided. All wallboard should be stored in a fully supported, flat position to avoid possible warping that may induce nail pops. If stacked vertically, warping is almost inevitable.

Cutting and scoring should be neat and accurate, with ends always square. Snugly fitted board is essential to a good end product. Wedging or forcing of the board into position must always be avoided because such procedures often cause poor nailing conditions, which can induce nail pops. If cut edges are rough, they should be neatly sandpapered.

The manner of nailing the board is most important. The board must be drawn tightly against the framing member so that there can be no movement whatsoever of the board on the shank of the nail. It is almost impossible to secure this intimate contact of board to framing member without holding the board tightly in position with the free hand while the nail is being driven and dimpled. It is a fallacy to believe that the head of the nail will draw the board up tightly to the framing member, even on side walls where the board hangs vertically.

### SINGLE LAYER APPLICATION

Single layer application is the most widely used method for gypsum wallboard interiors. There are two basic methods of application—horizontal and vertical. The horizontal method implies that the long edge of the board is placed at right angles, or across the framing members; whereas vertical application implies that the long edges of the board are parallel to, and immediately over, the framing members. The horizontal application is the preferred method unless it results in an unusual number of end joints that would require treatment. By virtue of the composition of the paper covering, the wallboard is considerably stronger when applied by the horizontal method.

Wallboard of  $\frac{1}{2}$ " minimum thickness is recommended for new construction; and the board should be ordered in lengths that will result in a minimum of end joints. If at all possible, the entire span of the ceiling or the wall should be covered with a single length of board. Ceilings should be erected first; and hanging of the board on side walls should start at the ceiling, with snug fitting corners. Ends and edges of all boards should occur over nailing members, except for treated joints at right angles to framing members in horizontal application.

Selection of the proper nail is vital to the excellence of the finished job (see Section II). Such nails should be spaced not less than  $\frac{3}{8}$ " from edges and ends of the wallboard—with a maximum of 7" on centers on ceilings, and a maximum spacing of 8" on centers on walls. Double Nailing is an alternate procedure for spacing nails and is described later. Please refer to paragraph 5.00 on page 2 of the ASA specifications; also page 3 for recommended nail spacing.

### Double Nailing

The "double nailing" system was developed to minimize or reduce nail popping caused by not holding the board tight against the framing member, or from shrinkage of framing lumber. This system provides for nailing 12" o.c. to secure the board to the framing member; then going back and placing a nail approximately 2" from the first driven nails. In this manner the applicator can use one free hand to hold the board tight to properly dimple the second nail. It may be necessary for him to hit the first nail again in order to draw it snug. For detailed recommendations on this method of application, see Fig. 1b on page 3 of the A.S.A. A97.1, 1958, Specifications.

### Floating Interior Angles

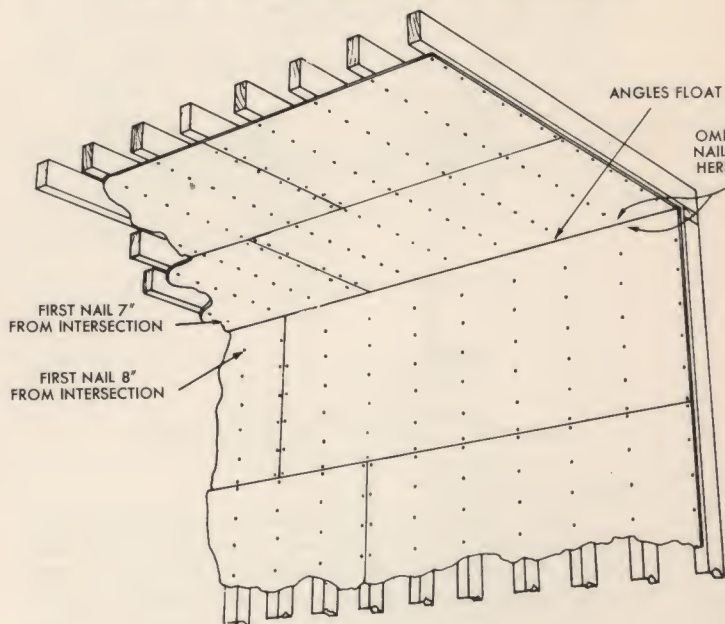
The "floating angle" method of application of gypsum wallboard was designed to provide for relief of stresses, which often occur at interior corners.

In this alternate method of application, certain nails may be eliminated in all interior angles, both at the horizontal angle where ceiling and sidewalls meet, and in the vertical angle where sidewalls intersect. The "floating" interior angle application method may be used with Conventional Nailing or "Double Nailing" as here indicated.

#### Conventional Nailing Method

##### Ceilings (always apply ceilings first)

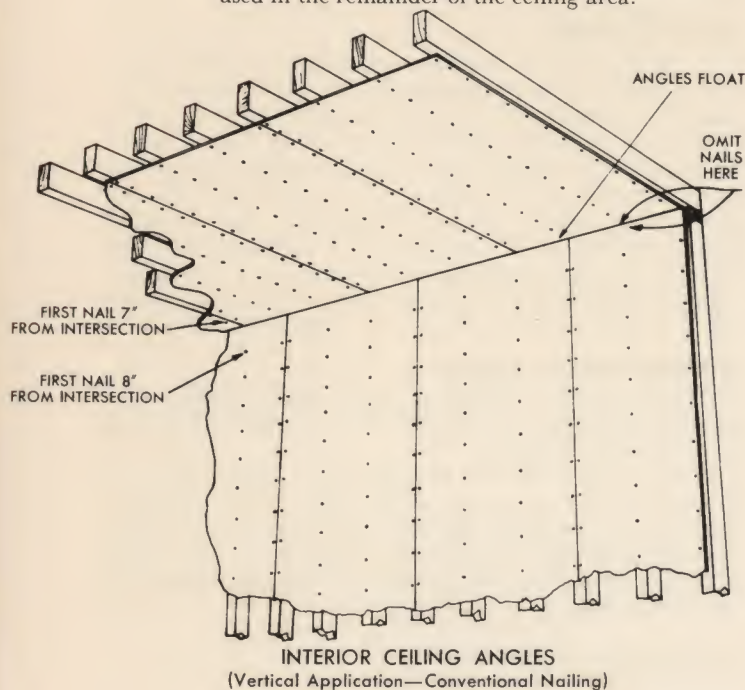
*Horizontal application.* Use recommended framing practices for corner nailing. Wallboard must fit snugly into all corners. Conventional nailing shall be used where the ends of the boards abutt the wall intersection. At the edges of the board parallel the intersection, the first nail shall be nominally 7" from the wall intersection. Conventional nail spacing shall be used in the remainder of the ceiling area.



INTERIOR CEILING ANGLES  
(Horizontal Application—Conventional Nailing)

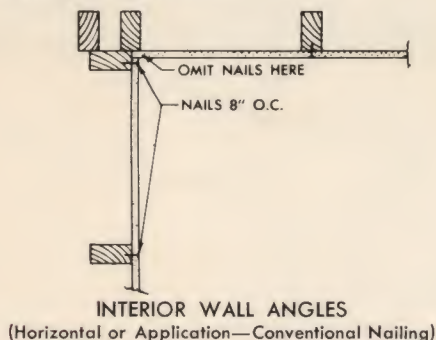


**Vertical application.** Conventional nailing shall be used where the long edges of the board abutt the wall intersection. At the wall and ceiling intersections where the ends of the board parallel the intersections, the first nail shall be nominally 7" from the wall intersection. Conventional nail spacing shall be used in the remainder of the ceiling area.



#### Sidewalls

All wallboard must be applied to maintain firm contact at ceiling line, in order to support the ceiling boards previously applied. Along the ceiling intersection, omit nails directly at the ceiling angle. The first nail shall be nominally 8" from the ceiling intersection. At all vertical interior angles, omit only the corner nailing of the board first applied and to be overlapped in the angle. The overlapping board is to be nailed in the conventional manner, 8" o.c. Conventional nail spacing shall be used in the remainder of the wall area.



#### Double Nailing Method

Refer to standard specifications for the "Double Nailing" method. Note that the perimeter nailing is the same as the "Conventional Nailing Method"; but that the field of the board is nailed in pairs (1½" to 2" apart), approximately 12" o.c. on both sidewalls and ceilings. To "float the corners" in the double nailing method, follow the

procedures listed under Conventional Nailing Method above as they apply to the perimeters of the gypsum board at the interior angles.

#### Adhesive Nail-On

The "adhesive nail-on" system for application of gypsum wallboard was developed to minimize the possibility of nail popping. It reduces the number of nails in the field by more than 50 per cent and provides for intimate contact, or bond, between the wallboard and the framing member. *In no instance should adhesive be used without supplementary attachment with nails.* The following recommendations should be followed for adhesive nail-on application:

##### Nails

Those corresponding with GDCI Performance Standard Requirements. (See Appendix).

##### Nail Spacing:

1. Job site application
  - 16" o.c. on sidewalls
  - 12" o.c. on ceilings
2. Each edge shall be nailed at every nailing member not less than ⅜" from the edge of the board.

Nails shall not be countersunk or removed.

##### Other Requirements

All other requirements shall be in accordance with the requirements of A.S.A. Specification A97.1, Gypsum Wallboard Finishes.

The selection of a proper adhesive is most important. Only adhesives as recommended by the manufacturer of the gypsum wallboard should be used.

#### Use in Bath and Shower Areas

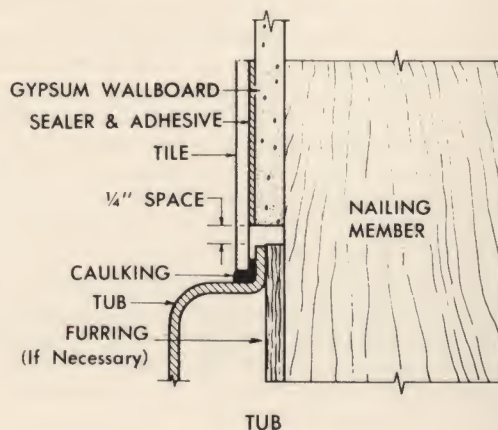
Gypsum wallboard is recommended around bathtubs and shower stalls for a base to receive ceramic, plastic, or metal tile applied by adhesive application. A summary of the necessary recommendations for a successful installation follows:

##### Framing

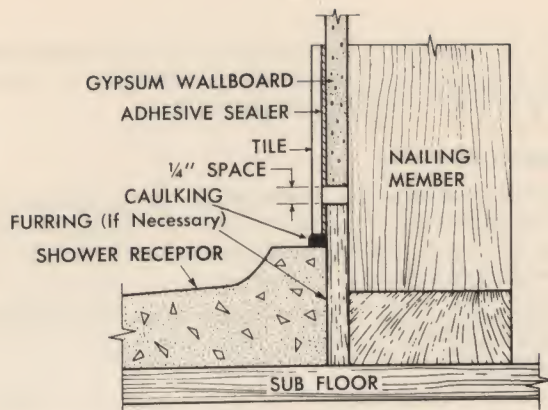
All framing around tub enclosures and shower stalls should permit the inside lip of the tub, prefabricated receptor or pan to be flush with the outside face of the wallboard. This may require furring of the studs behind the wallboard or the fixture.

##### Wallboard Installation

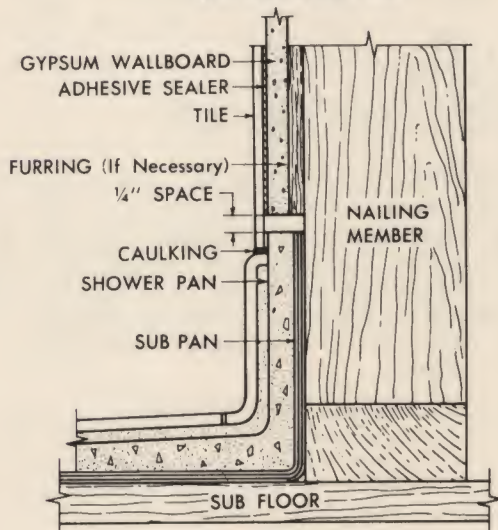
Use full size sheets to eliminate butt joints. The bathroom is one place where scraps of wallboard should never be used. Start with the paper bound edge of the wallboard down over the tub, receptor or pan . . . and allow ¼" clearance between the wallboard and the fixture. Never start with a cut edge here.







SHOWER RECEPTOR



SHOWER PAN

To properly position the wallboard above the fixture, insert a  $\frac{1}{4}$ " thick temporary wood spacer or drive nails  $\frac{1}{4}$ " above fixture. This space is necessary to prevent capillary action of water and to keep the board dry. After the wallboard is secured to the studding, the temporary spacer must be removed.

All joints should be treated with tape and two coats of joint cement (an adhesive).

#### Sealing

Waterproofing the wallboard surface is a most important operation. Before applying the tile or tile adhesive, apply a waterproof sealer to the entire surface of the gypsum wallboard and all edges of cutouts made for pipes or fixtures. It is extremely important that the entire surface be thoroughly waterproofed. Use a rubber base or varnish type sealer.

If a waterproof tile adhesive is used as a sealer, it should be applied in a separate operation  $\frac{1}{16}$ " thick, independent of application used for holding the tile.

With these steps completed, the wallboard is now ready for the application of adhesive to receive the bathroom tile. Once installed, the tile is grouted in the standard manner.

It is important to maintain  $\frac{1}{4}$ " clearance above the lip of the tub or shower receptor and the lower paper bound edge of the gypsum wallboard; and properly seal the gypsum wallboard surface. For additional detailed recommendations, see Appendix A of the A.S.A. A97.1, 1958 Specification in Section IX.

#### Exterior Use

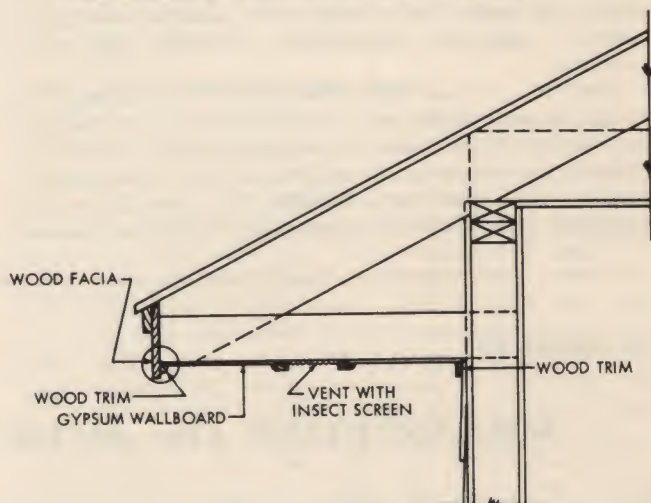
A rather recent innovation in the gypsum wallboard industry has been the use of this material in exterior locations, such as ceilings; protected walls of open carports and porches, and on the soffits of eaves. It has been proven to be a very satisfactory and effective material for such installations. It provides a highly crack resistant, joint free surface. In addition, a method of treating nail heads is also available.

Gypsum wallboard— $\frac{1}{2}$ " or  $\frac{5}{8}$ " thick—may be used for carport and open porch ceilings and the soffits of eaves that are horizontal or incline downward away from the building.

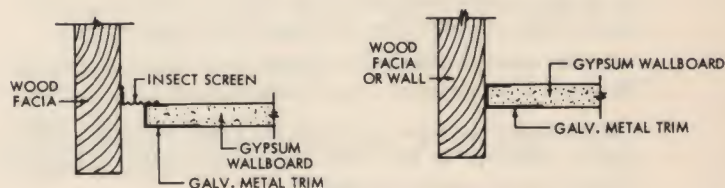
#### Materials and Application

Materials and application shall be in strict conformance with the requirements of American Standard for Gypsum Wallboard Interior Finishes A97.1, except as modified below:

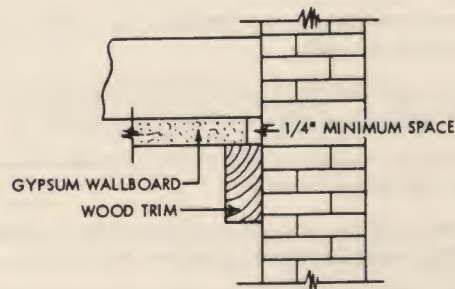
Suitable drips and mouldings shall be provided around the perimeter to protect wallboard surface from direct exposure to water. The edges of the board shall be placed not less than  $\frac{1}{4}$ " from masonry. (See drawing).



FRAME WALL



ALTERNATE FACIA DETAILS



MASONRY WALL



The wallboard shall be applied horizontally on nailing members spaced not to exceed 24" o.c. Joints may be covered with battens or finished with joint treatment. Nail-heads shall receive joint treatment in the usual manner.

#### *Ventilation*

Adequate ventilation shall be provided for the space immediately above such installations. (Note: The minimum acceptable ventilation shall be as required in the current Minimum Property Standards of the Federal Housing Administration).

#### *Painting*

The exposed surface of the board shall be painted with not less than two coats of exterior type oleo-resinous or water-thinned emulsion paint.

### **TWO-PLY APPLICATION OF GYPSUM WALLBOARD**

Two-ply gypsum wallboard is the ultimate in drywall construction. It is highly recommended in both residential and commercial constructions. It offers the following advantages: strength, endurance, increased fire resistance and sound insulation.

There are various application systems and methods for two-ply gypsum wallboard. Several satisfactory methods are described in Section 5.40 of A.S.A. Standard A97.1, 1958. For additional systems, consult manufacturer's recommendations.

Also available for use as the first-ply in two-ply gypsum wallboard construction is a product known as gypsum backing

board. It is similar to gypsum wallboard, except that a gray paper is used on both sides; and it is available in narrower widths for easier handling and application.

### **Stapling First-Ply**

An effective saving can often be made by the application of the first-ply of two-ply gypsum wallboard construction with power driven staples. When staples are used, the following recommendations should be observed.

*Staple Wire* 16 U.S. Standard gauge, flattened, galvanized.

*Staple Crown* Flat,  $\frac{1}{16}$ " wide (outside measure).

*Staple Legs*

For  $\frac{3}{8}$ " thick first-ply board—1" long with divergent points.

For  $\frac{1}{2}$ " thick first-ply board—1 $\frac{1}{8}$ " long with divergent points.

*Spacing of Staples*

Ceilings—not to exceed 7" on center.

Walls—not to exceed 8" on center.

Staples shall be driven with the crown at right angles to the paper bound edges of the wallboard, except where the paper bound edges fall on the framing members. Then, the staples shall be driven parallel to the edges. Staples shall be driven in such a manner that the crown bears tightly against the wallboard but does not cut into the face paper. The legs of the staple shall be no less than  $\frac{3}{8}$ " from the ends and edges of the wallboard.

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## **Section IV**

# **SELECTION OF JOINT SYSTEM PRODUCTS**

Since the excellence of the finished wallboard job depends to a large degree upon the quality of the joint work, it is important that joint materials of the highest quality be selected for the job. An otherwise good wallboard installation can be totally unsatisfactory if poor quality joint treatment materials are used.

A joint system consists of the reinforcing tape and the joint treatment adhesive which is used to embed and cover the tape.

Most reinforcing tapes used today are made from high quality papers, processed to the following characteristics which are necessary for good joint treatment:

1. Sized to prevent too rapid absorption of water from the embedding adhesive.
2. Strength so that the finished joint has sufficient resistance to transverse loads.
3. Low expansion when wetted with joint adhesive to prevent curling and edge cracking upon drying.
4. Porosity to moisture vapor so the joint adhesive under the tape will dry out readily.
5. Correct width so the joint will be properly covered. A 2" to 2 $\frac{1}{4}$ " width has been found very satisfactory.
6. Proper thickness so the joint may be covered easily. Tape should not exceed 0.012" in thickness.

### **JOINT TREATMENT ADHESIVES**

Adhesives may be of two kinds:

1. Used for embedding and covering the tape, and also spotting nail heads.
2. Used for topping or finishing over the tape and to spot the nail heads. This material should not be used to embed the tape. It is known as "topping" or "finishing" cement.

Joint Treatment Adhesives should have the following characteristics:

1. Sufficient cementitious qualities to bond firmly to the tape.
2. Low shrinkage so that joints and nail heads may be covered with minimum number of coats. (Three coats is considered minimum).
3. Fungicidal and bactericidal protection to prevent fungus growth before drying. Where high humidity conditions prevail, it is extremely important that the cementitious material be free from attack by bacteria before it can be used.

The "topping" or "finishing" adhesives must have the same general characteristics as bedding adhesive, except they may have a somewhat lower cementitious value because they are not used to embed the tape. This lower cementitious quality usually permits lower shrinkage and easier sanding.

Since different reinforcing tapes may possess varying bonding characteristics, as do joint adhesives, it is important that the tape and the joint adhesive be compatible.



## Section V

# JOINT AND NAIL HEAD TREATMENT

After making the proper selection of joint system products, the next and final step—prior to decoration—is the application of these joint system materials. Here again, it is important that proper procedures are followed. The recommendations of the manufacturer of the joint treatment material should be followed explicitly. In addition, there are other helpful suggestions included in this section that will aid in securing the best finished job.

### HEAT, VENTILATION AND DRYING

Joint cements are adhesive type materials that “dry.” They do not “set.” For this reason, heat and ventilation of the building become most important. A minimum temperature of 55°F. is recommended at all times until the joint adhesive is completely dry. It is also important that excessive temperatures be avoided. Should there be high temperatures (in the range of 100°F. or more) accompanied by ventilation or drafts, too rapid drying of the material will take place, and that is conducive to shrinkage. Care must also be taken when artificial heat is obtained through the use of salamanders or similar heating appliances. Use of these appliances can cause “hot spots” and create local areas of excessive shrinkage. They can also cause staining of the joint treatment.

Too little ventilation, even if the temperature is maintained above 55°F., can cause excessively slow drying. One must use good judgement in providing proper heating and ventilating conditions. It is recommended that the buildings be glazed, and that windows be open about 2" at the top and bottom.

Sufficient drying time between coats of joint adhesive and before decoration must be allowed. Under good drying conditions, 24 hours is usually sufficient; 16 hours is an absolute minimum. Under slow drying conditions, 24 to 48 hours or longer drying time between coats may be necessary.

### MIXING THE JOINT ADHESIVE

Joint adhesive is mixed with water by hand or by machine. When mixing joint adhesive follow the recommendations of the manufacturer. The “water-cement ratio” must be correct in order to obtain the proper consistency for good working characteristics and good performance.

The use of machine or power tools is found to be most effective. This is also true in mixing joint adhesive with water. By use of an electric drill, or other power type mixer with an appropriate mixing blade, a better mixing of the joint adhesive with the water is obtained.

The container used to mix the adhesive should be a clean metal or other non-absorbent type. Only clean, lukewarm water should be used, since dirty water can impair the bonding qualities of the joint adhesive. Always add the dry powder to the water. Mix for several minutes to make sure all of the powder is uniformly damp; and allow the wet mixture to stand for approximately 30 minutes. The use of excess water in the initial mixing will not accelerate the process, although the mix may appear to be at a workable consistency. It will soon be found that the use of excess water to obtain a working consistency immediately, produces a wet, sloppy mix that must be corrected by addition of more dry powder.

Following the addition of the proper amount of powder to the proper amount of water—and the 30 minute soaking—

again thoroughly stir or mix the wet adhesive. This insures the proper disbursement of all of the raw material ingredients and provides for a workable, creamy mix. During cold weather, a soaking time of longer than 30 minutes may be required.

### HAND APPLICATION

Before the actual application of the first coat, it is important that the entire wallboard installation be checked to insure that all nail heads have been properly dimpled in the surface of the paper, and also to insure that the wallboard has been drawn tight to the face of the framing members. Should there be evidence of loose board or poor nailing, the nails should be re-set, or drawn up; or in extreme cases, additional nails should be added. Loose nailing can be detected by placing a finger over the nail head and pressing firmly against the wallboard, adjacent to the nail, with the other hand. Movement can be detected by “feel” in the finger on the nail head.

#### First Coat (Embedding the Tape)

The first coat for treating the joints consists of applying the joint adhesive into the channel formed by the tapered edges of the board, or over the butt edges of the wallboard end joints. The adhesive should be applied evenly with a 4" or 5" steel joint cement finishing knife, or similar suitable tool. Avoid over filling; however, insure that enough adhesive is applied to provide for a satisfactory bond of the tape.

The tape is then applied over the center of the joint, with care taken to insure that the paper is centered and straight to avoid wrinkling or buckling. The tape is pressed into the previously applied joint adhesive by drawing the knife along the joint, over the tape, with sufficient pressure to remove excess joint adhesive. As soon as the tape is properly embedded, immediately cover it over with a thin layer of the joint adhesive to fill the recess between the taped edges and the flush board surface, or to cover the tape on “butt” joints. This practice will make the application of the second coat easier, and reduce the chance of shrinkage in the second coat.

If blisters develop under the tape—and if they cannot be laid down by working them over with the knife—they can be punctured with the corner of the finishing knife to let the air escape, and then pressed down. Blisters are usually caused by “starved” joints—insufficient adhesive.

(CAUTION: Do not use “topping” or “finishing” joint adhesive to apply the tape.)

#### Second Coat (Fill Coat)

After the embedding coat is completely dry (usually 24 hours), the second coat is applied. It should be applied with the 5", or wider, finishing knife or other appropriate thin steel type of tool. The edges of the second coat should be “feathered” out slightly beyond the edges of the first coat, usually 1" to 2", and slightly wider for butt joints. “Topping” or “finishing” joint adhesives may be used for this second step in lieu of embedding or regular adhesives.

#### Third Coat

After allowing sufficient drying time, the third coat is applied. Light sanding may be necessary between second and third coats, as well as between the first and second coats. When sanding, be extremely careful to avoid contact of the sandpaper with



the paper of the gypsum wallboard. Over-sanding will scrape the surface of the wallboard and raise the nap of the paper.

The third coat is applied in much the same manner as the second coat, "feathering" out an inch or two beyond the edges of the second coat. When the third coat is dry, it again should be lightly sanded. Over-sanding, in addition to raising the nap of the paper, can also cause "glazing" of the joint treatment material, which creates a difference in porosity and texture of the finished surface when paint is applied. "Topping" or "finishing" adhesives may also be used for the third coat.

### Spotting Nail Heads

Nail heads should be spotted at least three times. This is done in conjunction with the application of each coat to the joints. Again, light sanding may be necessary between coats and after the third or finishing coat; and the same precautions apply. In some instances, particularly where nails have been driven excessively below the surface of the wallboard, it may be necessary to apply four coats. The same drying time between coats should be allowed for nail head treatment as for joint treatment. "Topping" or "finishing" adhesives may be used for all three coats over nails, but the regular adhesive used for embedding the tape is satisfactory.

### Inside Corners

For treatment of inside corners, the reinforcing tape is folded along the center crease. Both sides of the interior angle are buttered with the joint adhesive, and the tape is then pressed into the angle—using the knife to embed the tape and to re-

move excess adhesive. After allowing proper drying time between coats, apply a second and third coat, spreading each coat one to two inches beyond the edge of the previous coat. Light sanding between coats may be necessary.

### Outside Corners

For outside corners, a metal type corner bead is recommended. It can be one of two types—either a solid metal corner bead which is nailed, or a metal bead with paper flanges for embedding in adhesive. Joint adhesive is then applied to each side of the bead in three coats, allowing ample drying time between coats and sanding, if necessary. It is important that the corner bead be applied "tight" against the corner and that the joint adhesive be "feathered" out for at least 10". This is particularly important at the floor, in order that the "base" can be drawn tight against the surface of the wall.

## MACHINE APPLICATION

There are available, and in general use today throughout the United States, "mechanical" type tools. Properly operated by skilled mechanics they have been found to do a good job of joint treatment.

The use of these tools requires that certain basic fundamentals be followed, much in the same manner as in hand application. This includes the proper mixing of the joint adhesive with water; providing proper heat and ventilation; allowing ample time for drying between coats, and a minimum of sanding between coats.

## Section VI

# DECORATION OF GYPSUM WALLBOARD

Prior to decoration, the gypsum wallboard finish should again be inspected, particularly the joint and nail head treatment. Imperfections should be sanded or repaired with joint adhesive. Prior to the application of any form of decoration, be sure the joint treatment is thoroughly dry. A minimum of 24 hours of good drying conditions is required.

With the joints and nail head depressions properly treated, interior walls of gypsum wallboard may be decorated in any of the popular variety of finishes, such as texture or stipple, smooth finish, flat or gloss paint or wallpaper. Because the porosity and texture of the wallboard differs from that of the joint adhesive, it is recommended that the surface be primed and sealed as may be required by the subsequent finish coats. In rooms where high humidity may be encountered, such as the kitchen, bath or utility room, a sealer is strongly recommended.

Care should be exercised in the selection of primer and sealer paints to make sure that they will perform satisfactorily, and fulfill the following functions:

1. Equalize variations of suction over the entire surface.
2. Provide a bonding surface or "tooth" for the paint to be applied.
3. Avoid nap raising.
4. Make the surface textures of the treated joints and the paper surface of the wallboard more uniform.

In general, the following types of primer sealers are recommended for the types of decoration listed:

1. *Casein and resin emulsion*—for these types of water thinned paints, a dry sealer or pigmented primer sealer should be used.
2. *Most latex paints* act as their own primer sealer, the first coat performing this function. However, an oil base

primer may be used.

3. *Oil or oleo-resinous paint or lacquer* require a pigmented primer sealer, a latex base paint or a lime locking cold water primer.
4. *Texture paints*, in general, should have a base coat of a pigmented primer sealer, although with many types of texture paints this is not necessary. Check manufacturers' instructions closely.
5. *Wallpaper*—a prime coat of latex base paint, or a good wall primer, or a coat of varnish or varnish size may be used to completely seal the surface before applying wallpaper. This will permit the later removal of the wallpaper without damage to the wallboard surface.

Before applying the primer or sealer, loose dirt and dust should be removed by vigorous brushing with a soft brush or by rubbing with a dry cloth. *Be sure the joint treatment is thoroughly dry before any application of sealer or paint.*

In applying primers or sealers, apply sufficient quantity to assure that the surface is completely covered. Follow manufacturers' printed directions and do not over-thin. It is good practice to tint the sealer to approximately the shade of the finish coat. This is conducive to better results in the finished job.

In all cases where deep tones are to be used in the finish paint, best results will be secured if the surface is first sealed. More than one coat of sealer may be necessary. Always be sure that each coat is thoroughly dry before applying another.

Under normal atmospheric conditions, a waiting period of 12 to 18 hours after application of primer-sealer should be observed before decoration is applied. In rainy, humid and cold weather, a longer waiting period—sometimes as long as 36 or 48 hours—may be necessary to make certain the sealer coat is absolutely dry.



## Section VII

# ELECTRIC RADIANT HEATING WITH TWO-PLY GYPSUM WALLBOARD

The following recommendations apply primarily to the application of the gypsum wallboard, and provide for its performance. Consult cable manufacturer or heating contractor for specific requirements pertaining to the heating system and its design. However, in all instances these recommendations must be complied with in order to insure satisfactory performance of the gypsum wallboard. If the electric heating system is not adaptable to these recommendations, the system should not be used.

### RECOMMENDATIONS FOR APPLICATION

The first layer of gypsum wallboard or backing board shall be applied horizontally to nailing members, as specified in Section 2.50 of A.S.A. A97.1, 1958 (see Appendix), using nails as specified in Section 3.60. Nails shall be spaced as specified in Section 5.17 except that nails shall be driven flush with surrounding wallboard surfaces.

Electric heating cable shall be securely attached to the base layer in accordance with cable manufacturer's recommendations—with cable parallel to and between nailing members. Cable shall be positioned at least  $1\frac{1}{4}$ " from center of nailing member on each side, so that at least a  $2\frac{1}{2}$ " unobstructed channel is provided under each nailing member. This is necessary to prevent nails (used subsequently to attach the face layer of gypsum wallboard) from being driven into the cable.

Cables shall cross nailing members only at ends of ceiling  $4"$  to  $6"$  from wall. There shall be at least a  $4"$  space completely around the perimeter of each ceiling that is clear of cables.

Cables shall be kept clear of openings by at least 8 inches. (See sketch).

Heating cable spacing between joists shall be as recommended by the heating cable manufacturer. *Under no operating conditions shall the gypsum board core exceed a temperature of  $125^{\circ}\text{F}$ .*

All inspections and testing of electric heating cables shall be completed before application of face layer of gypsum board.

Complete embedment of the heating elements is necessary. The area between the heating elements shall be filled and leveled with a filler to provide continuous contact between the face layer and the back layer of gypsum wallboard.

When required to produce a uniform thickness of the filler and to provide a firm base for nailing, furring strips of a thickness equal to that of the filler, may be placed over the first ply. Such strips should be attached to the ceiling joist at parallel relationship. The face layer shall be erected immediately after the filler has been spread.

Nails shall be of a length that will penetrate  $\frac{7}{8}"$  into the nailing members. The last nails around the perimeter of the ceiling shall be spaced  $8"$  to  $10"$  away from the joining wall to prevent them from striking the electric cables where they cross the framing members. All joints and nail heads shall be finished according to wallboard manufacturer's specifications.

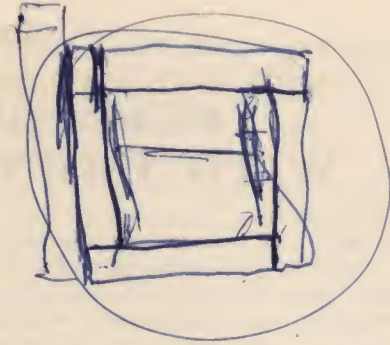
*Allow a minimum of one week under good drying conditions and two weeks in the cold season for drying of the filler before turning on the heating system.*

The first-ply may be attached using staples in accordance with the recommendations contained in Section III, Two-Ply Application of Gypsum Wallboard.



TYPICAL CEILING LAYOUT PATTERN WITH ELECTRICAL RADIANT HEATING



**DESIGN DATA****SPECIFICATIONS***Material*

Gypsum Wallboard .....	ASTM C36-58
Gypsum Backing Board .....	ASTM C442-59T
Methods of Testing .....	ASTM C26-56
Definitions .....	ASTM C11-58
Annular Ring (GWB-54) Nails .....	ASTM C380-58T

*Application*

American Standard Specifications for Gypsum Wallboard Finishes (See Appendix) .....	ASA A97.1, 1958
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**WEIGHTS**

Thickness of Wallboard in Inches	Weight per 1000 sq. ft., lb.	
	Minimum	Maximum
$\frac{1}{4}$	900	1300
$\frac{3}{8}$	1350	1800
$\frac{1}{2}$	1800	2500
$\frac{5}{8}$	2250	3150

**THERMAL CONDUCTIVITY VALUES**

Material	Conductance "C"	Resistance "R"
$\frac{3}{8}$ " Gypsum Wallboard .....	3.73	0.27
$\frac{1}{2}$ " Gypsum Wallboard .....	2.76	0.36
$\frac{5}{8}$ " Gypsum Wallboard .....	2.42	0.41
<i>Air Spaces</i>		
*Bounded by ordinary materials (Horizontal or Vertical) .....	1.10	0.91
*One air space faced with aluminum foil:		
Heat Flow Upward or Horizontally .....	0.46	2.17
Heat Flow Downward .....	0.15	6.51

\* $\frac{3}{4}$ " or more in width.

(NOTE: Foil back gypsum wallboard is an efficient vapor barrier—less than 0.50 perms.)



# FIRE RESISTANCE RATINGS

## WOOD JOIST FLOOR-CEILINGS—WOOD STUD PARTITIONS—STEEL COLUMNS WITH GYPSUM WALLBOARD

Rating	Material and Construction	Authority Test No.: §
	<b>FLOOR-CEILINGS</b>	
1 Hour	1" (Nominal) sub and finish floor, with building paper between. Ceiling of 2 layers of ½" regular gypsum wallboard with 1" hexagonal mesh between layers.	NBS 250
1 Hour	1" (Nominal) sub and finish floor, with building paper between. Ceiling of one layer of ⅝" Type "X" (Special Fire Retardant) gypsum wallboard. *	UL
0:45 Minutes	1" (Nominal) sub and finish floor with building paper between. Ceiling of one layer of ½" Type "X" (Special Fire Retardant) gypsum wallboard. *	UL
	<b>WOOD STUD PARTITIONS†</b> (Load bearing, except where otherwise indicated)	
1½ Hours	2 layers of ½" regular gypsum wallboard	NBS 227 & 228
1 Hour	1 layer of ⅝" Type "X" (Special Fire Retardant) gypsum wallboard. *	UL
1 Hour	2 layers of ⅜" regular gypsum wallboard.	Ohio State T118
1 Hour	1 layer of ½" regular gypsum wallboard with mineral wool batts nailed to studs.	NBS BMS 92
1 Hour‡	1 layer of ½" regular gypsum wallboard with mineral wool fill.	NBS BMS 92
0:45 Minutes	1 layer of ½" Type "X" (Special Fire Retardant) gypsum wallboard. *	UL
0:40 Minutes	1 layer of ½" regular gypsum wallboard.	NBS BMS 92
0:25 Minutes	1 layer of ⅜" regular gypsum wallboard.	NBS BMS 92
	<b>STEEL COLUMNS</b>	
2½ Hours	4 layers of ½" regular gypsum wallboard, adhesively applied to column and to each preceding layer. Wire ties around third layer.	NBS 315
1½ Hours	3 layers of ½" regular gypsum wallboard, adhesively applied to column and to each preceding layer. Wire ties around second layer.	NBS 304
1 Hour	2 layers of ½" regular gypsum wallboard, adhesively applied to column and to each preceding layer. Wire ties around first layer.	NBS 303

\*Type "X" (special fire retardant) designates gypsum wallboard, complying with these specifications, that provides at least: (1) 1-hr fire retardant ratings for ⅝ in. thick; or (2) ¾-hr fire retardant ratings for ½ in. thick gypsum wallboard applied in single layer nailed application on each face of load-bearing wood framing members when tested in accordance with the requirements of Methods of Fire Test of Building Constructions and Materials (ASTM Designation: E 119). Consult manufacturers for independent test data on assembly particulars, materials, and ratings for other types of construction.

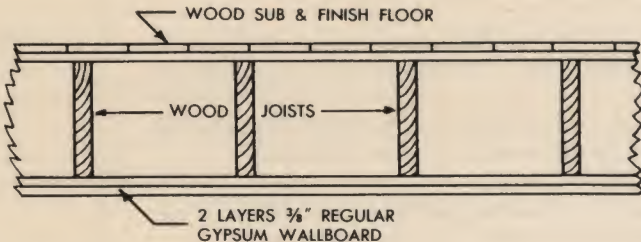
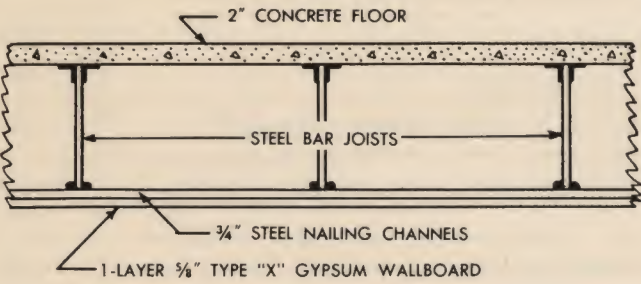
†Both sides finished as noted.

‡Non-load bearing only.

§UL: Underwriters' Laboratories.    NBS: National Bureau of Standards.    BMS: Building Materials and Structures Report.



## SOUND TRANSMISSION LOSS

FLOOR-CEILING ASSEMBLIES		
CONSTRUCTION	LOSS—DECIBELS	
 <p>WOOD SUB &amp; FINISH FLOOR</p> <p>WOOD JOISTS</p> <p>2 LAYERS <math>\frac{3}{8}</math>" REGULAR GYPSUM WALLBOARD</p>	40	
 <p>2" CONCRETE FLOOR</p> <p>STEEL BAR JOISTS</p> <p><math>\frac{3}{4}</math>" STEEL NAILING CHANNELS</p> <p>1-LAYER <math>\frac{5}{8}</math>" TYPE "X" GYPSUM WALLBOARD</p>	47	
GYPSUM WALLBOARD PARTITIONS		
LAYERS OF GYPSUM WALLBOARD	LOSS—DECIBELS	
	REGULAR 16" O.C. STUD SPACING	STAGGERED STUDS 16" O.C.
1—LAYER $\frac{1}{2}$ " REGULAR	35	42
1—LAYER $\frac{5}{8}$ " TYPE "X"	37	43
2—LAYERS $\frac{3}{8}$ " REGULAR	38	
2—LAYERS $\frac{1}{2}$ " REGULAR		43
2—LAYERS $\frac{5}{8}$ " TYPE "X"	40	45
2" SOLID LAMINATED GYPSUM WALLBOARD PARTITION (4—LAYERS OF $\frac{1}{2}$ " REGULAR BOARD)	37	



## **APPENDIX**

**Recommended Performance Standards  
for Nails for Application  
of Gypsum Wallboard**

**ASA Standard Specifications  
for Gypsum Wallboard Finishes**



# RECOMMENDED PERFORMANCE STANDARDS FOR NAILS FOR APPLICATION OF GYPSUM WALLBOARD

## 1. SCOPE:

This standard covers the recommended requirements for nails for the application of  $\frac{3}{8}$ ",  $\frac{1}{2}$ " and  $\frac{5}{8}$ " thick single ply gypsum wallboard to wood nailing members. It does not include application to metal members or the application of predecorated gypsum wallboard.

## 2. STEEL WIRE:

Steel wire used in the manufacture of nails shall be hard drawn basic wire of good commercial quality, entirely suitable for the purpose. Before fabrication it shall be sufficiently ductile to withstand cold bending, without fracture, through  $180^\circ$  on a radius not greater than the diameter of the wire (see Paragraph 9).

## 3. WORKMANSHIP AND FINISH:

The nails shall be bright, or chemically treated, or may be lightly coated with rust inhibiting material provided that such rust inhibitor does not adversely affect the performance of the nail, and is compatible with the nail head concealment and decoration. Nails shall be neatly formed and free from injurious defects or deformations.

## 4. LENGTH:

(a) The length of the nail shall be such as to provide a maximum penetration of  $\frac{7}{8}$  inch into the nailing member, except when fire resistive ratings are required. When so required the nails and spacing shall conform to the appropriate fire test data.

(b) Variations in length shall not exceed  $\pm \frac{1}{32}$  inch.

## 5. SHANK DIAMETER:

(a) The maximum nominal diameter of the shank shall be 0.099 inches.

(b) Maximum variations in diameter shall be  $\pm 0.003$  inches.

(c) Should a deformation process increase the diameter of the nail, a clearance area (smooth and unringed) shall be provided for the top  $\frac{1}{2}$  inch of the nail, as measured from under the head.

## 6. NAIL HEAD DIMENSIONS:

Nominal diameters of nail heads shall be  $\frac{1}{4}$  inch. Variations from nominal head diameters shall not exceed  $-\frac{1}{64}$  inch or  $+\frac{3}{64}$  inch. Nail heads shall be thin (approx.  $\frac{1}{64}$  inch) at the peripheral edge, shall be slightly tapered on the underside (approx.  $150^\circ$  deg. included angle), shall be smoothly blended to the shank with a fillet radius of approximately  $\frac{1}{32}$  inch, and shall be free from protrusions and sharp edges; or of other design which shall not break the paper of the gypsum wallboard when the nail head is dimpled below the wallboard surface.

## 7. NAIL POINTS:

The nails shall have a medium diamond point.

## 8. WITHDRAWAL RESISTANCE:

The minimum withdrawal resistance, immediate and delayed, shall be equal to that provided by  $12\frac{1}{2}$  gauge bright, smooth shank, nail with medium diamond point, hammer driven to a  $\frac{7}{8}$  inch depth of penetration into the longitudinal center line of both the edge and side faces of a single sample of nominal 2 x 6 inch Douglas fir, construction grade, containing at least 16% free moisture as determined by a Delinhorst moisture meter. The rate of withdrawal shall be 0.06 inch per minute.

Comparative test evaluations shall be made by alternately driving (staggered) 20 of the above described nails and 20 of the nails being tested, into each face of the 2 x 6 inch lumber for determining withdrawal resistance.

Comparative performance shall be determined as follows:

(a) By withdrawing immediately from both faces, 10 of each nail being tested.

(b) The lumber into which nails are driven shall be dried at 50% relative humidity and  $70^\circ \pm 5^\circ$  for 6 weeks, after which the remaining nails shall be withdrawn.

(c) The average withdrawal resistance for both immediate and delayed tests shall be recorded. The withdrawal resistance, immediate and delayed, for the nail being tested shall be at least equal to that of the  $13\frac{1}{2}$  gauge nail described herein.

## 9. BEND TEST:

The steel wire specimens shall be held in a vise and bent by means of a clamp or similar device, so attached to the free end of the specimen that the bend shall be confined to a length not exceeding twice the diameter of the specimen.

## 10. PACKING:

Unless otherwise specified, nails shall be packed in substantial commercial containers of the type, size and kind commonly used for the purpose, so constructed as to preserve the contents in good condition and to insure acceptance and safe delivery by common or other carriers, at the lowest rate, to the point of delivery. In addition, the containers shall be so made that the contents can be partially removed without destroying the container's ability to serve as a receptacle for the remainder of the contents.

## 11. LABELING AND MARKING:

Unless otherwise specified, individual packages and shipping containers shall be marked with the name, material, finish, size and designation of the contents, and with the name of the manufacturer. Individual packages shall also be marked with the name of the manufacturer and the net weight.

## 12. INSPECTION:

(a) Inspection may be made either at the point of manufacture or at the point of delivery. The inspector shall be afforded all reasonable facilities for inspection and sampling.

(b) Nonconformance with respect to length, diameter, and size of head shall be considered major defects and cause for rejection; corrosion and faulty shape shall be considered minor defects, and may be considered cause for rejection.

## 13. REJECTION:

Any rejection shall be based upon the specific cause of failure to conform to the requirements of these specifications, and shall be reported to the seller within ten working days from the receipt of the shipment by the purchaser.

## 14. REHEARING:

Claim for rehearing shall be valid only if made within 20 working days from receipt of notice of specific cause for rejection.





*Reg. U.S. Pat. Off.*

**A97.1-1958**

**UDC 691.31**

# **STANDARD SPECIFICATIONS**

**for**

## **GYPSUM WALLBOARD FINISHES**

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*Approved as*

**AMERICAN STANDARD**

**by The American Standards Association**

**October 29, 1958**

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**GYPSUM ASSOCIATION**



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American Standard  
By the American Standards Association  
ASA No. A97.1-1958: UDC 691.31

October 29, 1958

# AMERICAN STANDARD SPECIFICATIONS for GYPSUM WALLBOARD FINISHES

NOTE:—These specifications are intended to describe minimum requirements for application over wood nailing members. See Appendix for general information and recommendations pertaining to related work.

## 1.00 GENERAL PROVISIONS

- 1.10 The work includes all labor, materials, services, equipment, scaffolding and all operations required to complete the gypsum wallboard finishes in accordance with the drawings and these specifications.
- 1.20 Scaffolding shall be constructed and maintained in strict conformity with applicable laws and ordinances, and so as to avoid interfering with the work of others.
- 1.30 The work shall be properly coordinated with the work of other trades.
- 1.40 Whenever joint treatment adhesive is being mixed or used for applying tape or for laminating one layer of board to another, the temperature in the building shall be maintained at not less than 45 degrees Fahrenheit.

## 2.00 DEFINITIONS

- 2.10 **Gypsum Wallboard:** Where the term "Gypsum Wallboard" is used it refers to gypsum wallboard as defined in A.S.T.M. Specification C11-58.
- 2.12 **Type "X" (Special Fire Retardant) Gypsum Wallboard:** Wallboard which provides greater fire resistance as defined in A.S.T.M. Specification C36-58.
- 2.14 **Insulating Gypsum Wallboard:** Either Regular or Type "X" Gypsum Wallboard, with foil laminated to the back surface, as defined in A.S.T.M. Specification C36-58.
- 2.20 **Edges:** Where the term "edges" is used, it refers only to the paper-bound edges, usually the long dimension of the gypsum wallboard.
- 2.30 **Ends:** Where the term "ends" is used, it refers to the mill-cut or field-cut ends. At such cuts, the gypsum core is left exposed.
- 2.40 **Nailing Members:** Where the term "nailing members" is used, it refers to those portions of the framing, furring, blocking, etc., which serve as a nailing base to receive the gypsum wallboard. Unless otherwise specified herein, the nailing surface shall be not less than 2 inch nominal width. (See also Section A1.00 of Appendix)

2.50 **Horizontal Application:** Where the term "horizontal application" is used, it refers to gypsum wallboard application where the paper-bound edges are applied at right angles to the nailing members.

2.60 **Vertical Application:** Where the term "vertical application" is used, it refers to gypsum wallboard application where the paper-bound edges are applied parallel to the nailing members.

2.70 **Treated Joints:** Where the term "treated joints" is used, it refers to joints between gypsum wallboards which are reinforced and concealed with joint treatment.

2.80 **Untreated Joints:** Where the term "untreated joints" is used, it refers to joints which are left exposed in the finished work, or which may be covered by strips or mouldings.

2.90 **Joint Treatment Adhesive:** Where the term "adhesive" is used, in conjunction with joint treatment, it refers to "joint cement, an adhesive."

## 3.00 MATERIALS

The materials shall conform to the applicable requirements of the following specifications:

- 3.10 **Gypsum Wallboard:** A.S.T.M. Designation C36-58.
- 3.20 **Joint Treatment:** Joint reinforcing and adhesive materials shall be as recommended by the manufacturer of the gypsum wallboard.
- 3.30 **Laminating Adhesive:** Laminating adhesive material shall be as recommended by the manufacturer of the gypsum wallboard.
- 3.40 **Water:** Shall be clean, fresh and suitable for domestic consumption.
- 3.50 **Steel Nails:**
  - 3.52 **GWB-54 (Gypsum Wallboard):** Annular ringed nails complying with the requirements of A.S.T.M. Specification C380-58T.
  - 3.54 **4d** 14 gage, 1-3/8 in. long, 7/32 in. flat head, diamond point.
  - 5d 13-1/2 gage, 1-5/8 in. long, 15/64 in. flat head, diamond point.
  - 6d 13 gage, 1-7/8 in. long, 1/4 in. flat head, diamond point.



### 3.60 Nails for single layer application:

Gypsum Wallboard (Thickness)	Nails (To framing or furring of 2 in. or greater nominal thickness)	Nails (To 1 in. nominal thick furring over concrete or masonry)
1/4 in. (for application over existing surfaces)	Flat head, diamond point nail of such length as to give not less than 1 in. penetration into the nailing members.	
3/8 in. Regular or Insulating	1-1/8 in. or 1-1/4 in. GWB-54 or 4d	1-1/8 in. GWB-54 or 4d
1/2 in. Regular or Insulating	1-1/4 in. GWB-54 or 5d	1-1/4 in. GWB-54 or 4d
5/8 in. Regular or Insulating	1-3/8 in. GWB-54 or 6d	1-3/8 in. GWB-54 or 5d
1/2 in. Type "X" and Insulating Type "X"	5d	
5/8 in. Type "X" and Insulating Type "X"	6d	

### 3.70 Nails for Multiple Layer Installation: (See Section 5.40)

## 4.00 DELIVERY, HANDLING AND STORAGE

- 4.10 All materials shall be delivered in the original packages, container or bundles bearing the brand name and the name of the manufacturer or the supplier for whom the product is manufactured.
- 4.20 All materials shall be kept dry, preferably by being stored inside the building under roof. Where necessary to store gypsum wallboard outside, it shall be stacked off the ground, properly supported on a strong level platform and fully protected from the weather.
- 4.30 Gypsum wallboard shall be neatly stacked (flat), with care taken to avoid damage to edges, ends and surfaces.

## 5.00 APPLICATION OF GYPSUM WALLBOARD

- 5.10 General: Note: For framing requirements see Appendix, Section A1.00.
- 5.11 Gypsum wallboard shall be cut by scoring and breaking or by sawing, working from the face side. When cutting by scoring, the face paper shall be cut with a knife or other suitable tool. The gypsum wallboard shall then be snapped back away from the cut face. The back paper can be broken by snapping the gypsum wallboard in the reverse direction or the back paper can be cut. All cut edges and ends of the gypsum wallboard shall be sandpapered, where necessary, in order to obtain neat jointing when the wallboard is erected. Cut-outs for pipes,

fixtures, or other small openings shall be scored in outline before knocking out or shall be cut out with a saw or other suitable tool. Where gypsum wallboard meets projecting surfaces, it shall be scribed neatly.

- 5.13 In single layer installations, all ends and edges of all gypsum wallboard shall occur over nailing members, except that this is not required for treated joints at right angles to framing members in horizontal applications.
- 5.15 Gypsum wallboard shall be applied first to the ceiling and then to the walls. Wallboards of maximum practical lengths shall be used to minimize number of end joints. Boards shall be brought into contact, but shall not be forced into place. Where ends or edges abut, they shall be neatly fitted.
- 5.16 Nails shall be spaced not less than 3/8 inch from edges and ends of wallboard. Nails shall be spaced and driven a maximum of 7 inches on centers on ceilings, and a maximum of 8 inches on centers on walls (See Figure No. 1a) except as shown for "Double Nailing" procedure in Figure No. 1b. Perimeter nailing at the top and bottom is not required. Nails shall not be staggered on adjoining edges or ends. While the nails are being driven, the wallboard shall be held in firm contact with the underlying support. Nailing preferably should proceed from central portion of the wallboard toward ends and edges. The tool used for driving nails shall have a crowned face. The nails shall be driven home with the heads slightly below the surface of the gypsum wallboard, in a dimple formed by the crowned face of the driving tool striking the last blow. A nail set shall not be used and care shall be taken to avoid breaking the paper face.



## SINGLE NAILING

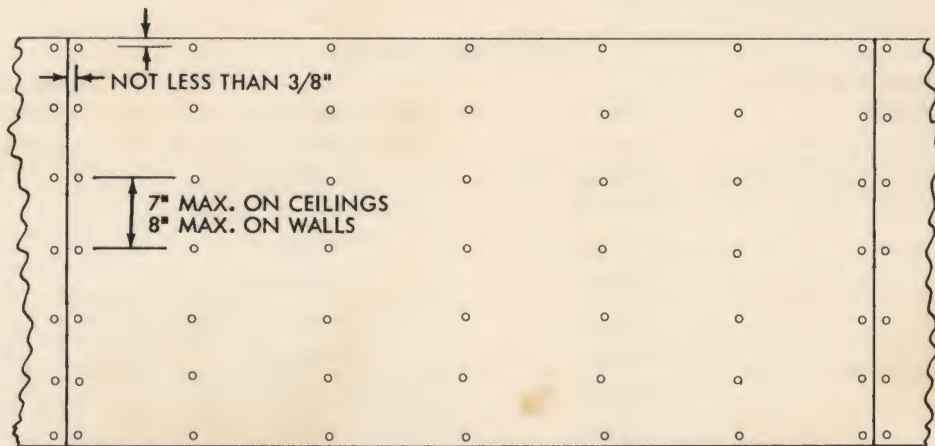


Fig. 1a

**NAILS:** Nails shall be in accordance with requirements of Paragraph 3.60.

**“SINGLE NAILING” SYSTEM PROCEDURE:** The wallboard shall be held in firm contact with the nailing member while the nails are being driven. Nailing preferably should proceed from the central portion of each piece of wallboard towards ends and edges. Nails shall not be staggered on adjoining edges or ends. Perimeter nailing at the top and bottom is not required.

## DOUBLE NAILING

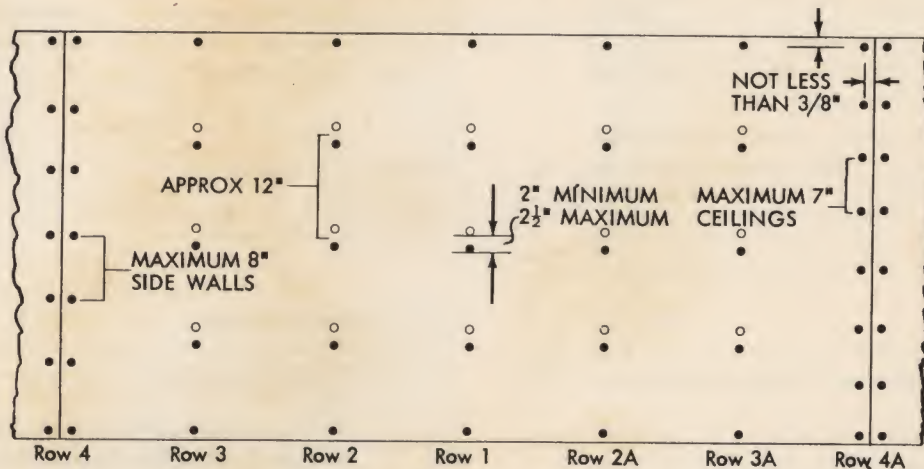


Fig. 1b

**NAILS:** Nails shall be in accordance with requirements of Paragraph 3.60.

**“DOUBLE NAILING” SYSTEM PROCEDURE:**

1. Two men are required to nail one ceiling board — one man nails rows 1, 2, 3 and 4; the other nails rows 2A, 3A and 4A.
2. Starting at center of board, nails shown by dot ● are applied in row 1, then rows 2 and 2A, 3 and 3A, 4 and 4A, etc., always nailing from center to edges of sheet.
3. Apply “double” nails shown by circle ○ in the same manner as first nails, also starting at row 1.
4. As alternate procedure, “double” nails may be applied immediately after nailing of first nails in each row is completed according to step “2” above.
5. Use single nails on perimeter of board.

**IMPORTANT:** All three field (first) nails in each row should be applied before the “double” (second) nails are applied. It may be necessary to “hit” the first nails in each row after the second nail is applied.



- 5.17 The maximum spacings for nailing members to receive gypsum wallboard constructions shall not exceed those shown in the following tables:

#### NAILING ONLY

Wallboard Construction	Use	Application	Maximum Spacing Nailing Members
3/8" (Single or two-ply)	Ceilings	Horizontal	16" o.c.
	Sidewalls	Horizontal or vertical	16" o.c.
1/2" single	Ceilings	Vertical	16" o.c.
1/2" single	Ceilings	Horizontal	24" o.c.
1/2" single	Sidewalls	Vertical or horizontal	24" o.c.
1/2" two-ply	Ceilings	Horizontal	24" o.c.
1/2" two-ply	Sidewalls	Vertical or horizontal	24" o.c.
5/8" single	Ceilings	Vertical	16" o.c.
5/8" single	Ceilings	Horizontal	24" o.c.
5/8" single	Sidewalls	Vertical or horizontal	24" o.c.
5/8" two-ply	Ceilings	Horizontal	24" o.c.
5/8" two-ply	Sidewalls	Vertical or horizontal	24" o.c.

#### TWO-PLY NAILING WITH ADHESIVE BETWEEN LAYERS

Wallboard Construction	Use	Application	Maximum Spacing Nailing Members
Two-ply (3/8")	Ceilings	Base layer horizontal	16" o.c.
Two-ply 1/2" base layer 3/8" face layer	Ceilings	Horizontal	24" o.c.
	Ceilings	Vertical or horizontal	24" o.c.
Two-ply 1/2" or 5/8"	Ceilings	Base layer horizontal	24" o.c.
Two-ply 3/8", 1/2" or 5/8"	Sidewalls	Horizontal or vertical	24" o.c.

- 5.20 Application direct to framing members or furring strips:

##### 5.22 Joints Treated:

- 5.222 End joints shall be staggered and joints on opposite sides of a partition shall be arranged to occur on different studs.

##### 5.24 Joints Untreated:

- 5.242 Unless otherwise specified, square edge, beveled edge and predecorated gypsum wallboard shall be applied vertically. Where the nail heads are to be treated, they shall be driven as specified in Paragraph 5.16. Where they are to be left with no further treatment, they shall be driven flush with the face of the wallboard surface without breaking the paper.

- 5.244 Wood grained and other predecorated gypsum wallboards shall be applied using a nail with a suitably colored head. These nails shall be driven with a hard rubber mallet or plastic head hammer.

- 5.26 Ceiling application over wood furring construction:

When gypsum wallboard is nailed to wood cross furring on ceilings these members shall have a minimum cross section of 2" x 2" (nominal) and be spaced in accordance with the requirements of Paragraph 5.17.

- 5.30 Application over existing plaster or gypsum wallboard surfaces:

- 5.32 Where gypsum wallboard is used over uneven existing plaster or gypsum wallboard surfaces and joints are to be treated, the wallboard shall be nailed to furring strips as specified in Paragraph 3.60.

- 5.34 Where existing plaster or gypsum wallboard surfaces are in suitably sound condition and of such nature as to permit proper nailing, the gypsum wallboard may be applied direct. Nails shall be so located and of such length as to penetrate into framing members not less than one inch. They shall be spaced and driven as specified in Paragraph 5.16.



#### **5.40 Two-Ply Gypsum Wallboard Application:**

##### **5.42 Adhesive Used Between Layers:**

5.422 The two layers may be applied in opposite directions or in parallel direction. Joints in the exposed layer need not occur over supports. If the face layer is to be permanently held in place by adhesive only, the first layer shall be applied as specified for single layer application, except that the nails shall be driven so that their top faces are flush with the surrounding wallboard surface. The adhesive to be used between the two layers of gypsum wallboard shall be spread evenly over the back surface of the face layer of the wallboard before it is erected, using a spreader of design approved by the manufacturer of the gypsum wallboard. Immediately after the adhesive has been spread, the wallboard shall be placed in position and nailed with a sufficient number of nails to hold the wallboard in place until the adhesive develops adequate bond. In lieu of nailing, the second ply of gypsum wallboard may be held in position by shoring with props and headers or other temporary supports to insure adequate pressure for bonding.

5.424 When adequate bond has developed between the wallboards, the temporary supports shall be removed, or, if temporary nailing is used, such nails shall either be: (a) driven home so that their heads are below the surrounding surface of the gypsum wallboard, in a dimple formed by the final blow of the driving tool, or (b) removed, or (c) driven with a nail set so that heads of the nail are well below the surface of the exposed face of the gypsum wallboard. The resulting holes shall be filled flush with joint adhesive.

##### **5.44 No Adhesive Used Between Layers:**

Nails for the first layer shall be spaced a maximum of 14" on centers, and shall be of the size and type required for the particular thickness of board when used in single layer application. The face layer shall be nailed with the number of nails required for normal single layer application. Nails used for the face layer shall be long enough to penetrate at least 1-1/8 inches into nailing members. The two layers may be applied in opposite directions or in parallel directions. The nails in the first layer shall be driven home so that their heads are below the surrounding surface of the gypsum wallboard. Nails for the face layer shall be driven as specified in Paragraph 5.16.

##### **5.50 Insulating Gypsum Wallboard:**

5.51 The application of insulating gypsum wallboard shall conform to the foregoing specifications for the application of gypsum wallboard. The reflective surface shall be placed against the inside face of the nailing members.

5.52 Insulating gypsum wallboard shall not be used as the backing material in shower stalls or tub enclos-

ures to receive ceramic, plastic, or metal tile, or plastic finished wall panels.

NOTE: To obtain full efficiency as an insulating material, a minimum of 3/4 inch air space shall be provided next to the foil.

#### **6.00 JOINT TREATMENT FOR FIELD JOINTS AND CORNERS**

6.20 Treatment for field joints and corners shall be applied in strict accordance with the printed instructions of the manufacturer of the gypsum wallboard. Ample drying time shall be allowed between coats of adhesive and between finish coats and decoration. Before joint treatment is applied the installation shall be inspected to insure that (1) gypsum wallboard is properly nailed and is held tight against the nailing members, and (2) nail heads in the field of the board are slightly below the surrounding surface in dimples formed by the driving tool.

6.30 External Corners: External corners shall be protected and finished with reinforcing joint tape and adhesive or with an approved metal or other type corner protection.

6.40 Arches: Where gypsum wallboard is to be applied to the soffit of arches it shall be carefully bent into place. If necessary, it first shall either be dampened or be kerfed approximately one-inch on centers on the back side. In the latter case, after the core has been broken at each cut, the wallboard shall be applied to the curved contour and nailed in place. At the arrises of the arch, joint adhesive and reinforcing shall be applied in the manner specified for corners, except that the tape shall be snipped at intervals along one side to permit it to conform to the curved contour. Approved metal or other corner protection may be used at these locations.

#### **7.00 STUDLESS SOLID GYPSUM WALLBOARD PARTITIONS**

7.10 Solid gypsum wallboard partitions consisting of multiple layers of gypsum wallboard shall be erected in accordance with the printed directions of the manufacturer of the gypsum wallboard.

#### **8.00 TOUCHING UP PRIOR TO DECORATION**

8.10 After trim has been applied, and prior to decoration, surface damage and defects shall be corrected (See Appendix, Section A2.00).

#### **9.00 VENTILATION ABOVE GYPSUM WALLBOARD CEILINGS**

9.10 Proper ventilation shall be provided (See Appendix, Section A4.00).



# APPENDIX A

## A0.00 APPENDIX

This Appendix gives general information and also suggestions for inclusion to be made elsewhere by specifier. It is not part of these specifications.

## A1.00 FRAMING REQUIREMENTS

The work of framing and furring is not part of these specifications. However, certain requirements covering framing, nailing members, spacing, etc., are essential to provide a proper base to receive the gypsum wallboard. The following requirements should be included in the project specifications for wood framing and furring.

- A1.10 All nailing members should be straight and true and spaced not to exceed the maximum spacings shown in Paragraph 5.17. Framing and bridging members should be adequate to carry the design or code loading. The deflection of horizontal members supporting gypsum wallboard shall not exceed  $1/360$  of the span. The nailing surface of any framing or furring member should not vary more than  $1/8$  inch from the plane of the faces of adjacent framing or furring members. Headers should be provided as necessary for the support of fixtures. Nailing surfaces shall have a minimum width of  $1-1/8$  inches.
- A1.30 Headers are not required to receive joints at right angles to supports in horizontal application that are to be treated with a joint reinforcing system.
- A1.50 All concrete or masonry surfaces that are to receive gypsum wallboard finish should be furred with at least  $1" \times 2"$  nominal nailing members.
- A1.70 Nailing flanges of insulating materials should not be attached to the face of the nailing member.

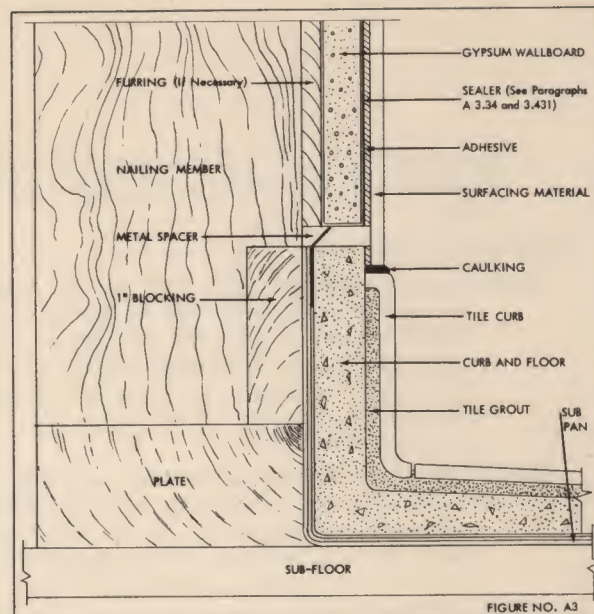
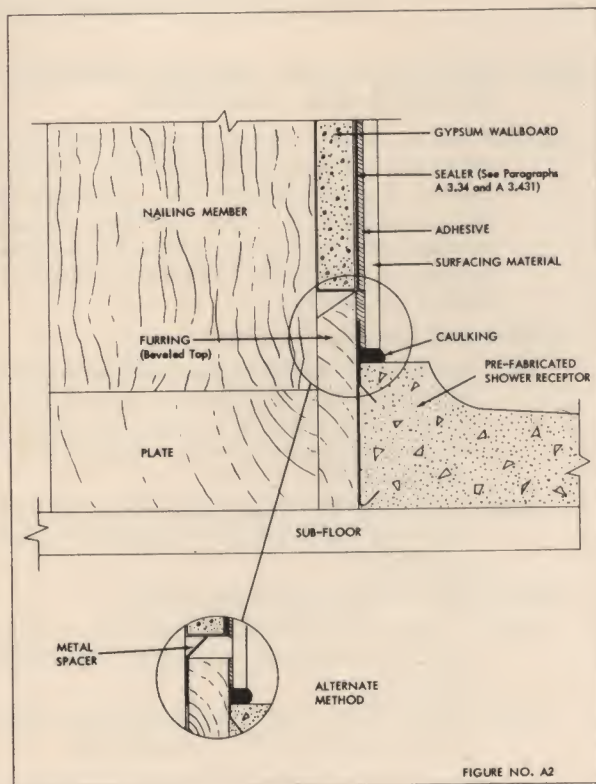
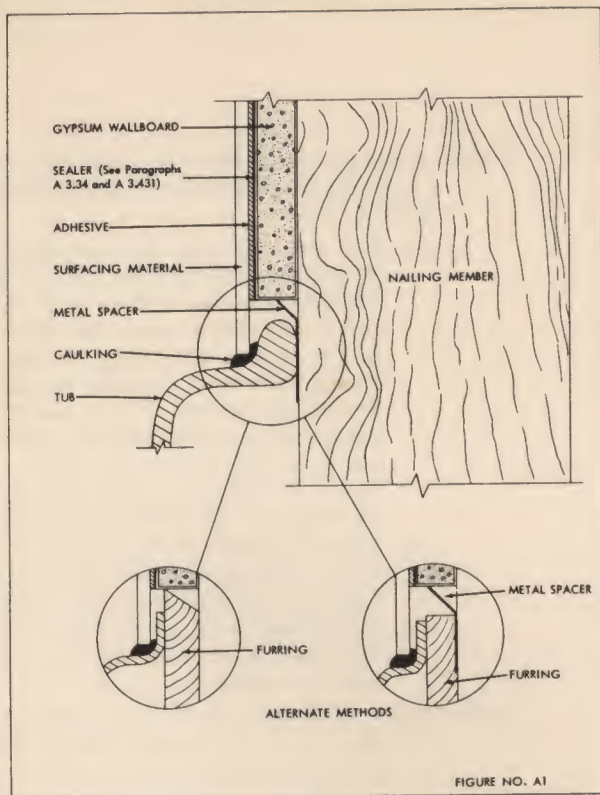
## A2.00 DECORATION

- A2.10 It is extremely important that the difference in absorption between the field of the gypsum wallboard and the adhesive over joints or nailheads be equalized to assure uniformity of color and texture over the entire wall. After the gypsum wallboard application has been completed, the surfaces should be sealed and primed as required for subsequent finish.
- A2.20 Wallpaper and similar materials applied adhesively: Wallpaper, or similar materials adhesively applied, should never be applied to gypsum wallboard without first sealing the surface. Sealing provides protection where wetting of the gypsum wallboard may occur. In general, latex or oleo-resinous type sealers, recommended by the gypsum wallboard manufacturer, can be used. Use of a sealer provides protection for the wallboard when removal of the wallpaper becomes necessary.

## A3.00 SPECIFICATIONS FOR APPLICATION OF GYPSUM WALLBOARD TO RECEIVE CERAMIC, PLASTIC, METAL TILE, AND PLASTIC FINISHED WALL PANELS BY ADHESIVE APPLICATION

- A3.10 General: The work to be done in application of gypsum wallboard under this specification shall be performed in accordance with the requirements of American Standards Association, Standard Specification for Gypsum Wallboard Finishes A97.1, except as otherwise specified herein.
- A3.20 Framing: (See figures A1, A2, and A3)
- A3.21 Framing members shall be plumb and true.
- A3.22 All framing around tub enclosures and shower stalls shall allow sufficient room so that the inside lip of the tub, prefabricated receptor or hot mopped sub-pan shall be even with the face of the gypsum wallboard. This will necessitate furring out from the studs the thickness of the gypsum wallboard to be used ( $3/8"$ ,  $1/2"$ ,  $5/8"$ ) less the thickness of the lip, on each wall abutting a tub, receptor or sub-pan.
- A3.23 Furring of the proper thickness shall be applied as required parallel to the lip of receptor, pan or tub. The top of square cut furring, or if beveled, the start of bevel shall be flush with the upper edge of receptor, sub-pan or tub. (See Figures A1, A2 and A3).
- A3.24 A continuous metal spacer strip as specified under Paragraph A3.33 shall be applied with the  $3/4"$  leg behind the furring with the apex of the angle abutting the top surface of the furring and the  $3/8"$  leg protruding away from the stud face. If a metal spacer strip is not used, the wood furring must be beveled. (See Figures A1, A2, and A3).
- A3.25 For walls to be surfaced with ceramic tiles over  $1/4"$  thick: When  $3/8"$  gypsum wallboard is to be used on studs spaced  $16"$  o.c. or  $1/2"$  or  $5/8"$  gypsum wallboard on studs spaced more than  $16"$  o.c., suitable blocking shall be installed between all studs. One row of blocking shall be located approximately  $1"$  above the top of the tub or receptor and another row at the mid point between the tub and ceiling. Blocking is not required for  $3/8"$  gypsum wallboard on studs spaced  $12"$  o.c. or less, or for  $1/2"$  or  $5/8"$  gypsum wallboard on studs spaced  $16"$  o.c. or less.
- A3.26 Appropriate blocking, headers or supports shall be provided to support tub, other plumbing fixtures, and to receive soap dishes, grab bars, towel racks and similar items as may be required.





### A3.30 Materials:

**A3.31** Gypsum wallboard shall be  $\frac{3}{8}$ ",  $\frac{1}{2}$ " or  $\frac{5}{8}$ " in thickness and shall comply with the requirements of ASTM Designation C36 for Gypsum Wallboard.

**NOTE:** Insulating (foil-backed) gypsum wallboard shall not be used as a backing material in shower stalls or tub enclosures.

**A3.32** Materials for treating joints and concealing nail-heads shall be as recommended by the manufacturer of the gypsum wallboard.

**A3.33** The metal spacer strip shall be fabricated of 16 gage galvanized steel, with one leg  $\frac{3}{4}$ " wide and one leg  $\frac{3}{8}$ " wide bent at a  $45^\circ$  angle.

**A3.34** The surface sealer shall be either a water resistant adhesive recommended by the manufacturer of the surfacing material or a water resistant sealer as recommended by the manufacturer of the gypsum wallboard. The sealer shall not be applied until after the joints are treated. Shellac shall not be used.

**A3.35** The adhesive used for application of the surfacing material shall be approved by the manufacturer of the surfacing material for use over gypsum wallboard.

**A3.36** The surfacing material shall provide a durable surface and prevent the passage of free water to the backing material; also, it shall prevent the passage of water vapor which may lead to condensation within or on the surface of the backing material or framing members.

**A3.37** Waterproof receptors, pans or sub-pans shall have an upstanding lip or flange which shall be a minimum of 1" higher than the water dam or threshold contained in the entry way to the shower.

### A3.40 Application:

**A3.41** Shower pans, receptors or tubs shall be installed prior to the erection of the gypsum wallboard. They shall be properly furred away from the framing members as specified in Paragraph A3.22, and installed so that the inside surface of the lip or



upstanding leg of the receptor or pan shall be in alignment with the surface of the gypsum wallboard.

#### **A3.42 Gypsum Wallboard:**

**A3.421** Gypsum wallboard, 3/8", 1/2", or 5/8" shall be applied horizontally with the factory edge (paper bound) abutting the top edge of the metal spacer strip or beveled furring, which shall allow a minimum of 1/4" space between the lip of the receptor, tub or sub-pan and the gypsum wallboard.

**A3.422** Gypsum wallboard shall be nailed as required in the foregoing specification. Where gypsum wallboard is to receive ceramic tile over 1/4" thick, the nails used to attach the gypsum wallboard shall be spaced a maximum of 4" o.c.

**A3.423** All joints between adjoining pieces of wallboard, including those at all angle intersections, shall be treated. (See Paragraph 2.70).

#### **A3.43 Application of surfacing material:**

**A3.431** Prior to the erection of surfacing materials, the approved type of sealer shall be applied to all gypsum wallboard areas including treated joints and angles which are to receive such surfacing materials. When the adhesive is used as a sealer, it shall be applied as a separate operation, independently of the application used to adhere the surfacing material, spreading it in a continuous coating approximately 1/16" thick. All edges of cut-outs made in the gypsum wallboard for pipes, fixtures, etc., shall be sealed in a like manner.

**A3.432** Prior to the erection of surfacing materials, all openings around pipes, fixtures, etc., shall be caulked flush with waterproof, non-hardening caulking compound.

**A3.433** The surfacing material shall then be applied down to the top surface or edge of the finished shower floor, return, or tub and installed so as to overlap the top lip of receptor, sub-pan or tub.

**A3.434** The surfacing material shall be applied so as to completely cover the following areas:

- (a) over tubs without shower heads—6" above the rim of the tub.
- (b) over tubs where showers occur—a minimum of 5 feet above the rim or 6" above the height of the shower head, whichever is higher.
- (c) Shower stalls—a minimum of 6 feet above the shower dam or 6" above the shower head, whichever is higher.
- (d) All jambs in shower stalls shall be covered to a like height.
- (e) The surfacing material shall be carried to the full specified height for a distance of at least 4" beyond the external face of the tub or receptor. Areas beyond an exterior corner are excluded.

**A3.435** Where plastic finished wall panels are used as a surfacing material, the following precautions shall be taken:

(a) Only the type and shape of mouldings recommended by the manufacturer of the surfacing material shall be used. All interior and exterior angles shall be treated with mouldings containing a flange projecting behind the surfacing material on each leg of the angle. Only recommended tub mouldings shall be used at the base where the surfacing materials abut the tub, shower floor, or curb. Such mouldings shall be set in caulking compound.

(b) A bead of caulking compound shall be applied at the angle formed by the gypsum wallboard backing and the moulding used around the top edge of the surfacing material to prevent leakage of water behind the moulding.

**A3.436** Where other types of surfacing materials are used, the following precautions shall be taken:

(a) All joints shall be filled in such manner as to leave no voids for water penetration.

(b) Nonsetting caulking compound shall be applied between the wall surfacing materials and the floor of the shower or rim of the tub.

(c) The angle between the edge and the surfacing material shall likewise be caulked.

### **A4.00 VENTILATION ABOVE GYPSUM WALLBOARD CEILINGS**

**A4.10** Attics or similar unheated spaces above gypsum wallboard ceilings shall be adequately ventilated as follows: Provide effective cross ventilation for all spaces between roof and top floor ceilings by screened louvers or other approved and acceptable means. Net ventilating area for each separate space shall be not less than:

#### **A4.20 Roofs with slope 2 in 12 or greater:**

**A4.21** 1/300 of the horizontal projection of the roof area over each space, provided that at least 1/2 of the required ventilating area is in the upper part of the ventilated space, as near the high point of roof as practicable.

**A4.22** 1/150 of the horizontal projection of the roof area over each space if not in compliance with Paragraph 4.21.

#### **A4.30 Roofs with slope less than 2 in 12:**

**A4.31** 1/300 of the horizontal projection of the roof area if a completely continuous vapor-barrier is provided.

**A4.32** 1/150 of the horizontal projection of the roof area if such a vapor-barrier is not provided.

**NOTE:** A vapor-barrier is a material having a vapor permeability not exceeding one (1) perm.



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